STUDIES ON POSTMORTEM DISACCHARIDASE ACTIVITY IN THE SMALL INTESTINE MUCOSA

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Disaccharidases are unevenly distributed within the small intestine tract (2, 11). Their activity in the duodenum is practically by half lower than that in the jejunum and ileum (4). It is increased in the beginning of the jejunal mucosa and gradually reaches its maximum in the jejunum and in the initial part of the ileum. Thereafter, the activity of disaccharides is again decreased and falls to a minimum in the distal parts of the ileum, where usually the lactase activity disappears (3, 4, 6, 7—9). Various laboratories claim different normal values for the individual disaccharidases, but almost invariably the ratio maltase: isomaltase: saccharase: lactase is approximately constant, namely 6 : 2 : 2 : 1 (6). In comparison with the rest of disaccharidases, the lactase activity in adults and children above 1 year is weaker in all the sections of the small-intestinal tract (1, 4, 5, 6, 7, 8, 9, 10). This is also confirmed by personal investigations on cadaveric and intraoperatively obtained material (3).

Material and Method

Investigation was made of 165 samples from small-intestinal mucosa, obtained from three deceased patients and 144 samples from 6 abortive or prematurely born fetuses from the 3rd to 8th month of pregnancy. Only the saccharase, lactase and partially the trehalose activity of the mucosa were studied with a semi-quantitative (qualitative) method, described in detail by the same author in an earlier report (3): a piece of the small-intestine mucosa, measuring 4—5 mm was incubated in a humid chamber at 37° C for 45 minutes with 0.15 ml disaccharidase substrate solution in mallein buffer at pH 5.8 (3, 7). Hydrolysis was demonstrated by the presence of glucose in the substrate solution with the aid of glucose-oxidase indicator papers Biophan G (3). Depending on the concentration of glucose and colour of the test-papers, the disaccharidase activity was recorded as follows: with 0 — absence; + weak; ++ moderate and +++, ++++ pronounced activity. The results of the investigations are illustrated in Table 1 and Figures 1 through 9.

It is evident from the table that more than two thirds of the samples investigated from cadaver No 1 and more than half the samples from cadaver No 3 show moderate (++) to pronounced (+++, ++++) disaccharidase activity. A similar finding is established only in 27% of the samples

Table 1

Small intestine mucosa from:	Samples No	Disaccharidase activity in the mucosa: 0			+			++			+++			++++			Diagnosis
		S.	L.	Tr.	S.	L.	Tr.	S.	L.	Tr.	S.	L.	Tr.	S.	L.	Tr.	
1. Cadaver 12 hrs after exitus	50	—	6	—	3	2	—	2	—	—	3	17	—	17	—	—	Brain stroke
2. Cadaver 16 hrs after exitus	100	6	17	—	19	1	—	13	2	—	5	—	—	7	—	—	Brain tumour
3. Cadaver 7 hrs after exitus	15	—	—	1	1	1	3	1	1	1	1	3	—	—	2	—	Ca stomach with metastasis
4. Abortion — III month	21							6	—		2	2	4	5	—	2	
5. Abortion — IV month	24													8	8	8	
6. Abortion — IV month	21	—	—	—	—	—	—	—	1	—	1	6	—	4	1	8	
7. Abortion — VI month	30	—									1	1	3	9	9	7	
8. Abortion — VII month	24	—	—	—	1	1	1	2	2	2	5	2	5	—	3	—	
9. Premature delivery — VIII month	24							1					1	8	7	7	

from cadaver No 2 in which in 20% the activity is weak (+), and in 53% — disaccharidase activity is absent. The samples from the small intestine mucosa of abortive and prematurely born, death fetuses investigated show rather strong disaccharidase activity. In Figs. 1—9 the results are presented graphically.

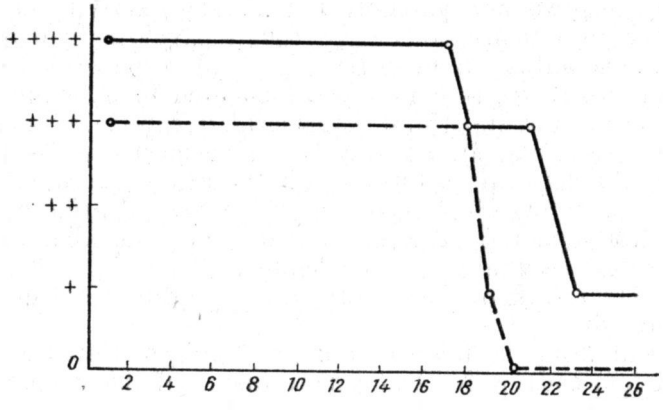

Fig. 1

Fig. 1: Cadaver of a patient, aged 55 years, dying from brain stroke against the background of hypertonic condition. The samples for investigations were obtained 12 hours after the death from the jejunum and ileum from points distant 20 cm from each other. The saccharase (——) and lac-

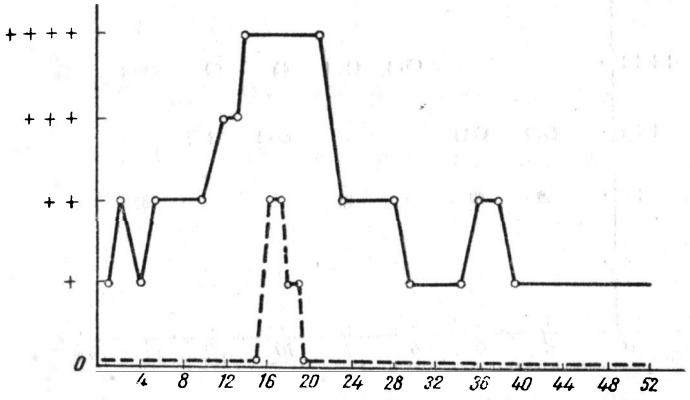

Fig. 2

tase (- - -) activity of the mucosa was studied. Pronounced activity (+++, ++++) of both disaccharidases was established. The lactase activity disappeared in the ileum at a distance 120 cm from the cecum. The saccharase activity also decreased and in the last 60 cm of the ileum it was weak(+). Fig. 2: Cadaver of a 60-year-old patient dying from unmetastasized brain

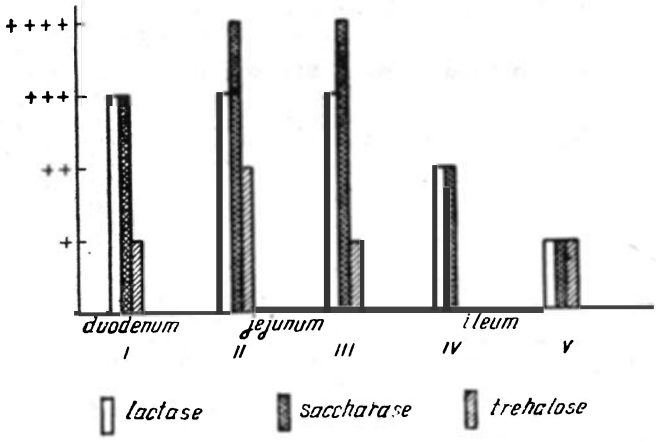

Fig. 3

tumour. The samples from the mucosa were obtained 16 hours after the exitus from 10—15 cm distant sites. The first two samples were from the duodenal mucosa, and the remaining — from the jejunum and ileum. The lactase activity in this case is absent in the duodenum and along a considerable length of the jejunum. Slight to moderate lactase activity was estab-

lished in a restricted sector (35—45 cm) of the jejunum. The lactase activity in the ileum was absent. In the duodenal mucosa the saccharase activity was weak to moderate (++). It showed a gradual increase in the jejunum (up to +++, ++++), and was again lowered in the ileum to

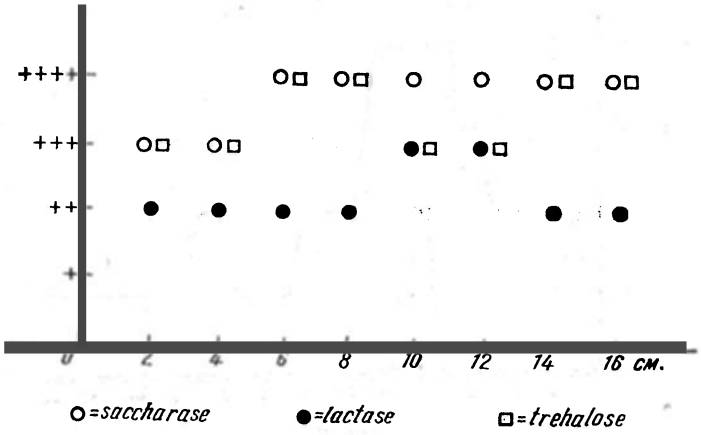

Fig. 4

moderate (++) and weak (+) saccharase activity, preserved unaltered throughout its terminal portions.

Fig. 3: Cadaver of a 60-year-old patient, dying from carcinoma in the stomach with metastases in the peritoneum and ascites. The samples for investigation were prelevated 7 hours after the death from the mucosa

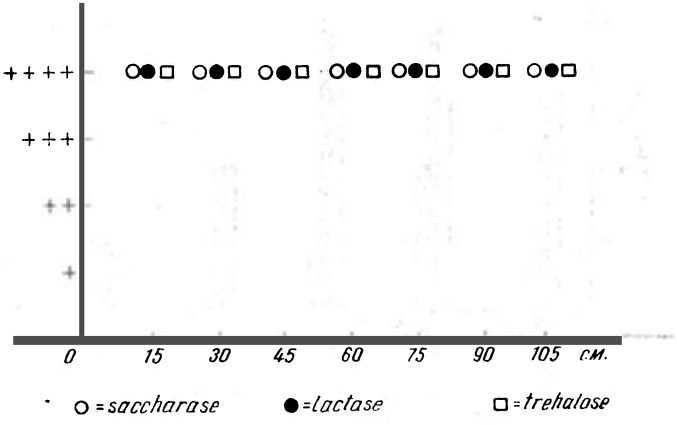

Fig. 5

of the duodenum (I), of the jejunum at 30 cm (II) and 150 cm (III) from the end of the duodenum, and from the ileum at 150 cm (IV) and 30 cm (V) from the cecum. The lactase and saccharase activity is well pronounced (+++) in the duodenal mucosa and in the jejunum (+++, ++++), and was moderate (++) to weak (+) in the ileum. The trehalose activity in most of the areas investigated was weak.

The samples from the small intestinal mucosa of the abortive and prematurely born fetuses were prelevated $^1/_2$ to 2 hours after the abortion and were investigated immediately:

Fig. 4. Abortion at 3rd month of pregnancy. The lactase activity was moderate in 6 and well pronounced in 2 of the samples investigated, distant

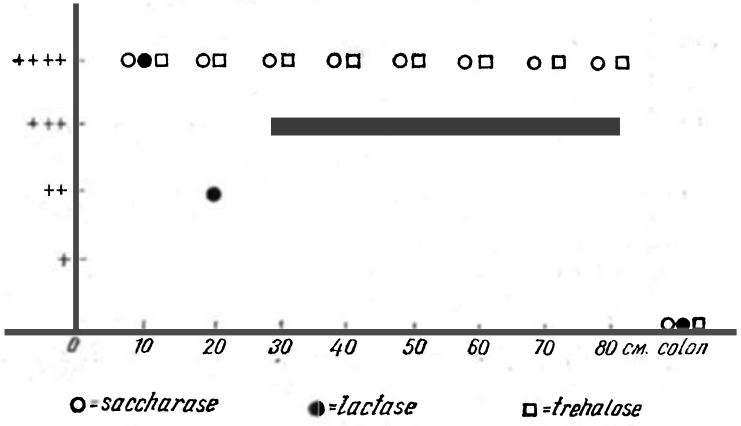

Fig. 6

2 cm from each other. The saccharase activity was strongly pronounced in all the samples.

Fig. 5: Fetus aborted at 4-month pregnancy after lifting a weight. Pronounced (++++) saccharase, lactase and trehalose activity was established in all the samples investigated, obtained from the jejunum and part of the ileum, distant 15 cm from each other.

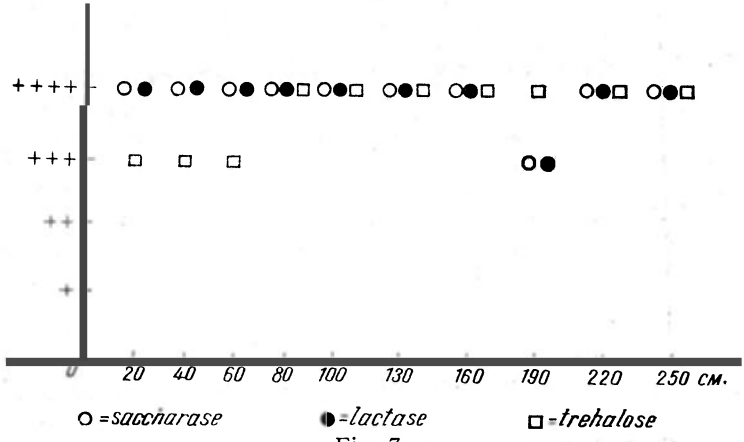

Fig. 7

Fig. 6: Aborted fetus at the 4th month of pregnancy. The samples were obtained from the jejunum and ileum, distant 10 cm from each other. In all samples, the saccharase and trehalose activity were well pronounced (++++). The lactase activity showed slightly lower values. The disaccharidase activity in the colon sample was absent.

Fig. 7: Abortion at 6th month of pregnancy. The samples were prelevated at intervals of 20 cm and 30 cm from each other. In all samples of the small intestine mucosa the activity of the three disaccharidases was well pronounced (+++, ++++).

Fig. 8: Abortion at the 7th month of a patient affected with nephropathia gravidarum. The saccharidase, lactase and trehalose activity within

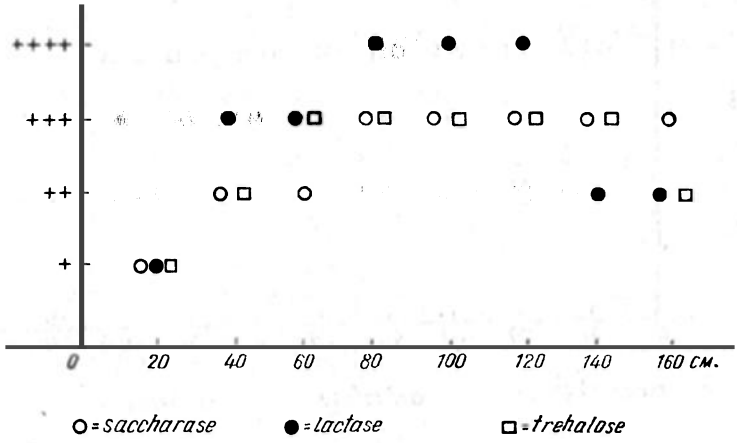

Fig. 8

the first 20—40 cm of the jejunum mucosa was weak (+) to moderate (++). Subsequently, the activity of three disaccharidases showed an increase (+++), and particularly the lactase activity (++++), which in the ileum decreased to moderate (++) values, whilst the saccharase activity

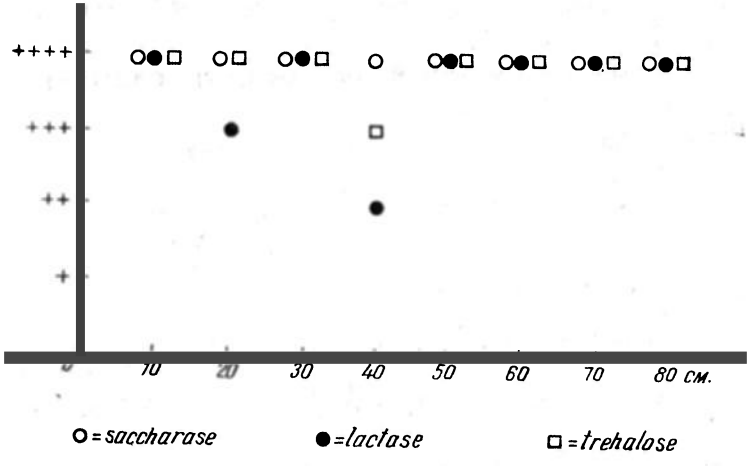

Fig. 9

was maintained strong along the entire length of the ileum segment investigated. Trehalose activity was similarly reduced (++).

Fig. 9: Premature birth at the 8th month of pregnancy. The samples of the small intestine mucosa were obtained from the jejunum and from the initial portion of the ileum, from points distant 10 cm from each other. The activity of the three disaccharidases, with small exceptions concerning the lactase, was well pronounced.

Discussion

Data concerning postmortem studies of disaccharidase activity in the small intestinal mucosa were not found in the pertinent literature in this country. In the foreign literature surveyed, we failed to come across reports on investigations of postmortem material. Aurichio and co-workers studied fetuses and established glycosidase activity on the third month of embryonic development (1). Our own investigations also show the presence of disaccharidase activity in the epithelium of the small intestines of fetus, as early as on the third month of embryonic development. The disaccharidase activity is well pronounced after the 4th month of pregnancy. Of the three disaccharidases investigated, the lactase activity reveals a higher degree of susceptibility to pathological conditions. The impression is that disaccharidase activity in fetuses is preserved at a higher degree than in the cadavera of adults. Contributing factors in this respect are the early term of investigation and the sterility of the small intestinal tract of the fetus. The causes of the abortions were hardly fully clarified in all of our cases, but nevertheless, in 5 of the fetuses the conclusion was reached that the disaccharidase activity was not influenced by them in as much it was very well manifested.

The fetus of the patient with nephropathia gravidarum, on the 7th month of pregnancy, disclosed a slight lactase, saccharase and trehalose activity in the initial tracts of the jejunum and quicker fall of the lactase and trehalose activity as compared to the saccharase one.

The results recovered from the investigated cadaveric material of deceased adult patients show a certain interdependence with the time of taking the samples elapsed after the occurrence of clinical death. The highest percentage of low values (73%) is observed in the material obtained latest — 16 hours after the exitus. Along with that, jejunal sections were established with preserved disaccharidase activity. The microbic flora and cadaveric decomposition have obviously exerted certain influence on the results recovered (Fig. 2). In two of the deceased (Fig. 1 and 3), the disaccharidase activity shows comparatively higher degree of conservation upon prelevating the material 12 and 7 hours after the clinical death, which underscores the resistance of disaccharidase enzymes. Before their death, in neither of the three patients with fatal outcome were symptoms established characteristic of disaccharidase insufficiency.

From the results of our studies, certain general regularities become apparent during the investigation of biopsy and intraoperatively obtained material from the mucosa, such as the weaker activity of disaccharidases in the duodenum and in the terminal portions of the ileum to complete disappearance of lactase activity.

Conclusion

The investigations made on saccharase, lactase and trehalose activity in the small intestine mucosa of deceased patients and abortive human fetuses after the third month of pregnancy show the significance of the postmortem study of disaccharidase ferment. If the obtaining of more reliable results concerning the true distribution of disaccharides in the small intestine tract is aimed, it will be necessary that the material for investigation be taken within the very first hours after the clinical death. The study of abortive fetuses immediately after the abortion demonstrates the presence of lactase, saccharase and trehalose activity as early as on the 3rd month of pregnancy. In the later terms of pregnancy, the three disaccharidases studied (and, no doubt, the remainder as well) reveal a strongly pronounced activity. The study of fetuses might be employed also in some genetic investigations.

REFERENCES

1. Aurichio, S., A. Rubino, G. Mûrset. *Pediatrics,* 35, 1965, 944.
2. Dahlqvist, A. J. *Anal. Biochem.,* 1964, 7, 431.
3. Димитров, Д. Ив. Под печат. I-ви конгрес по клин. лаборатория. София 12—14. XI. 1970 г. стр. 24
4. Govin, B. *Vie Méd.,* 49, 1968, 1285.
5. Jos, J., J. Fresal, J. Rey, M. Lamy. *Nature,* 213, 1967, 516.
6. Kistler, H., U. P. Haemmerly. *Internist,* 7, 1966, 242.
7. Newcomer, A. D., D. B. Mc Gill *Gastroenterology,* 51, 1966, 465.
8. Oproiu, A l., C. Oproiu. *Med. Int.,* 1866, 1151.
9. Sheehy, T. W., P. R. Anderson. *Lancet,* 1965, 1
10. Welsh, J. D., G. V. Rohrer, R. Drewry, J. C. May, A. Walker. *Arch. Int. Med.,* 117, 1966, 495
11. Zoppi, G., B. Hadorn, R. Gitzelman, H. Kistler, A. Prader. *Gastroenterology,* 50, 1966, 557.

ИССЛЕДОВАНИЯ ПОСТМОРТАЛЬНОЙ ДИСАХАРИДАЗНОЙ АКТИВНОСТИ В СЛИЗИСТОЙ ТОНКОГО КИШЕЧНИКА

Д. И. Димитров

РЕЗЮМЕ

С помощью полуколичественного (качественного) метода исследовались 165 проб слизистой тонкого кишечника, взятых у трех умерших больных и 144 проб, взятых у 6 выкидишей и преждевременно рожденных на 3-м—8-ом месяце беременности. При этом исследовалась сахаразная, лактазная и трехалазная активность слизистой.

Уже на третьем месяце беременности и в последующие месяцы дисахаридазная активность тонкокишечного эпителия плода была хорошо выраженной. Дисахаридазная активность установлена и в эпителии тонкого кишечника исследуемых трупов.

Автор делает вывод, что достоверные результаты распределения дисахаридаз в слизистой тонкого кишечника у трупов и плоде возможно получить лишь в том случае, если материал для исследования берется непосредственно или в первые часы после клинической смерти или аборта.